

On the Spinning-Glands in *Phrynus*; with an Account of the so-called "Penis" and of the Morphology of the Operculum.
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[Read 20th December, 1894.]

(PLATE VIII.)

A FEW months back my friend Mr. R. I. Pocock, of the British Museum, called my attention to the fact that, in tearing the cocoon of *Phrynus*, short threads were drawn out, which seemed to indicate the presence of spinning-glands; and he suggested that I should investigate the point. On clearing and mounting, the cocoon appeared to be a tough yellowish transparent membrane strengthened by threads which wound about it without any regularity, but which evidently formed the attachment of the cocoon to the under surface of the operculum. These threads varied greatly in thickness, being here uniformly thick, there uniformly thin, again elsewhere changing gradually from thick to thin.

Two young specimens at my disposal (unfortunately not well preserved) were cut into serial sections without, however, revealing any traces of spinning-glands. It seemed, therefore, highly probable that (as in the *Chernetidæ*) the spinning-glands in *Phrynus* are subject to periodic variations, *i. e.* develop only when required for the formation of the cocoon.

Light has, however, recently fallen upon the subject from an unexpected source. My attention was called (again by Mr. Pocock) to the so-called "penis" of *Phrynus*, which occurs presumably in the males. I had never seen this structure although I had examined a good many specimens of *Phrynus*. I had found it figured by Blanchard, who also calls it a penis. In order to facilitate the investigation, Mr. Pocock kindly allowed me to examine a specimen of *Tarantula tessellata*, Poc.*, belonging to the Natural History Museum, and also an excised "penis" which he had in his possession. As I was unable to dissect or section the specimens, the description can only be complete as far as it goes.

* Described and figured in "Arthropod Fauna of the West Indies," Journ. Linn. Soc., Zool. xxiv. p. 531.

The "penis" is a paired structure, the tips of its two limbs project backwards from beneath the genital operculum. The general character of these limbs can be gathered from the figures. They distinctly belong to the genital operculum, being outgrowths from its posterior wall, as shown in the diagrammatic longitudinal section (Pl. VIII. fig. 6). Anteriorly (or ventrally) they are attached almost immediately to the fold of the operculum, which has itself a distinct median suture. Posteriorly (or dorsally) the "penis" is attached far up to the opercular fold.

The genital aperture, opening on the posterior face of the operculum, is found in the channel formed by these limbs, so that the genital products can be conducted backwards to between the tips of the limbs, which tips are soft-skinned, somewhat spoon-like processes covered with fine hairs. The floor of the channel is continued to the posterior end of the limbs by a membrane joining the two longitudinally (*cf.* figs. 2-5). The structure so far seems to be an instrument for placing the genital products, *i. e.* either a penis for the placing of the spermatophores, or an ovipositor.

The study of these specimens further showed that this so-called "penis" functions not only as a genital organ, but also as a pair of spinning-mamillæ for the formation of the cocoon.

The secretion for the formation of the cocoons appears to exude on the anterior (ventral) side of the horizontal uniting membrane, from somewhere in the inner angles at the bases of the soft tips of the limbs. I was unable to find the exact apertures, but conclude that the secretion does exude from this spot from the fact that in the specimen examined a fragment of a membranous network made of clear, hard, thick irregular threads, with apparently open meshes, still remains tightly clutched by the "penis" (as shown in fig. 1). And further, among the torn and disorganized muscles of the excised "penis," a gelatinous mass, evidently one of the glands, persisted *in situ*, somewhat as shown in fig. 2. The gland belonging to the right side had been torn away in the process of excision.

The delicate tips of the organ, when not in use, are protected under the anterior edge of the sternite of the third abdominal segment (fig. 6). This figure [since confirmed by new sections] also illustrates the position of the spinning-gland.

mentary appendages of the second segment. It seemed very improbable that the rudimentary appendages of the first segment had fused longitudinally with those of the second segment.

The actual method of fusing, it seems to me, is made quite clear by the specimen of *Tarantula*, the operculum of which is here drawn (Pl. VIII. fig. 1). The conditions there seen may be explained by assuming that the limbs of the first abdominal segment folded together backwards in the median line, as shown in the diagram (fig. 7); they thus passed between the rudimentary limbs of the second segment. The large plate of the present genital operculum is thus a composite structure. The anterior and median posterior portions belong to the appendages of the first segment; the lateral portions are the remains of the limbs of the second segment which have been folded back over the stigmatic apertures*.

The amount of fusion between the two pairs of rudimentary appendages composing the genital operculum is therefore not great. We only require the fold growing backwards from the (? first joints of the) first pair of limbs to fuse on each side of the median line with the inner edges of the limb-buds or prominences of the second pair. Anteriorly and laterally, both the rudiments were confluent with the abdominal surface.

In this way the difficult morphological problem presented by the genital operculum of the Pedipalpi is not hard to solve. It is clearly an acquirement within the Arachnidan phylum, and not, as Laurie claims, a primitive feature inherited from Eurypterine ancestors. In the first place, the evidence which Laurie† adduces in favour of the existence of a large operculum covering two segments in *Slimonia* is far from conclusive; and, in the second place, if it were, it would not necessarily bring the Eurypterids any nearer to the Arachnids. As Laurie appears to recognize, if such a genital operculum were a primitive feature of the Pedipalpi inherited from Eurypterine ancestors, it would imply that the Arachnids are not a natural group, inasmuch as the genital operculum in all the other important Arachnids is more primitive than it is in the Pedipalpi. Fortunately there

* I have briefly discussed this method of folding down in "Vestigial Stigmata in the Arachnida," *Ann. & Mag. N. Hist.* xiv. 1894, p. 149.

† "The Anatomy and Relations of the Eurypteridæ," *Trans. Roy. Soc. Edinb.* xxxvii. (2) 1893.

is no necessity to alter the classification in the way Laurie proposes.

The second point of interest with regard to this pair of appendages on the first abdominal segment lies in the evidence they yield us as to the original character of these limbs, which are now, as a rule, throughout Arachnids reduced to mere scale-like opercula, either fused in the middle line (*Chernetidæ*) or free (*Scorpio* and *Galeodes*). We have here certain witness that these limbs were once cylindrical appendages. The same conclusion can also be arrived at for *Thelyphonus*, the genital operculum of which is constructed on the same plan as that of *Phrynus*. In addition to these facts, we have the filamentous genital organs of the Phalangidæ very probably also to be deduced from limbs. When, further, on the second abdominal segment we have the (? three-jointed) pectines of *Scorpio*, and, still further, on the fourth and fifth segments the four-jointed mamillæ of certain Aviculariidæ, we have, it seems to me, fairly conclusive evidence that the abdominal appendages of the Arachnida, which have now so generally vanished, were jointed limbs like those of the thorax.

Whenever, therefore, among the vestiges of limbs on the abdomen we get anything more than a flat scale-like structure, it is not a leaf-like limb at all, but a typical filamentous and sometimes jointed appendage. We conclude, therefore, that the scale-like opercula (genital or stigmatic) of the Arachnida have no connection whatever with the leaf-like limbs of *Limulus*. The latter are most probably, it appears, persistent phyllopodan limbs*, while the former are the vanishing remains of jointed filamentous limbs.

Apart from all theories as to the origin of the Arachnida, the evidence to hand tends to show that the primitive form possessed a pair of jointed limbs with a pair of stigmata on every segment, thoracic and abdominal; and that, as above stated, there was very little differentiation among the segments. The specialization of the first six segments with their appendages for prehension and locomotion, and of all or of some of the remaining segments as a highly distensible vegetative sac, constricted off by

* Cf. Beecher, "Appendages of the Pygidium of *Triarthrus*," Amer. Journ. Sci. ser. 3, vol. xlvii. p. 298 (1894); and "The Systematic Position of the *Tribolites*," Quart. Journ. Geol. Soc., Aug. 1894.

a waist or diaphragm, accounts for the secondary degeneration of the limbs in this latter region.

From the operculum of *Thelyphonus* both the projecting limbs have now disappeared, as is also the case in many Phrynidæ. Their disappearance is, however, marked in the latter by the pair of rounded membranous eminences bearing the claw-like rods described and figured by Pocock, and perhaps also in the former by certain chitinous ridges visible on raising the operculum.

The fact that the "penis" is clutching what looks like the remains of a cocoon (fig. 1), and, from what we have seen, might quite as well be an ovipositor as a penis, inclines me to think that the occasional presence of these limbs may be reversionary, and not in any way indicative of sex. It is possible that we have here a case of dimorphism. Whereas a majority of the Phrynidæ, and, indeed, of Arachnida, have lost the distal portion of the genital limbs, they may occasionally reappear in the Phrynidæ, in which group perhaps, to judge from the character of the operculum, they persisted longer than in those Arachnids in which the opercula are now reduced to mere scales.

EXPLANATION OF PLATE VIII.

- Fig. 1. Three anterior abdominal segments of *Tarantula tessellata*, Poc., ventral surface, showing the so-called "penis" tightly clutching a small fragment of a cocoon.
2. The ventral (morphologically anterior) view of the "penis," after removing the opercular fold, showing the mass of the (left) gland which secretes the material for the cocoon.
 3. One tip of the same more highly magnified, showing the delicate tips of the organ. The gland opens somewhere among the folds at the inner base of these delicate tips.
 4. Dorsal (morphologically posterior) view of the limbs forming the "penis;" deep down in the channel between them anteriorly is the genital aperture.
 5. One tip of the same, more magnified.
 6. Diagrammatic longitudinal section to illustrate the position of the "penis" when not used, and of the secreting-gland.
 7. Diagram to show the relation of the limbs of the genital segment to those of the next following segments, to illustrate the probable origin of the large genital operculum of the Pedipalpi (*cf.* fig. 1).
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On the Insects other than Coleoptera obtained by Dr. Anderson's Collector during Mr. T. Bent's Expedition to the Hadramaut, South Arabia. By W. F. KIRBY, F.L.S., F.E.S.

[Read 7th March, 1895.]

THE insects to which the present paper relates, as well as the *Coleoptera*, *Arachnida*, and *Myriopoda* noticed in the succeeding papers, were presented to the British Museum (Nat. Hist.) by Dr. John Anderson, F.R.S., on condition that, after being worked out, a set of the duplicates should be forwarded to the Museum at Cairo. The *Coleoptera* have been dealt with by Mr. C. J. Gahan, and the remaining insects by myself. There were no *Lepidoptera* in the collection, and the *Neuroptera* and *Diptera* were represented only by a single species each. The *Arachnida* and *Myriopoda* have been worked out by Mr. R. I. Pocock.

A considerable number of specimens were obtained, but most of them belonged to three or four species only, and the total number of species in the collection (many of which were represented by a single specimen only) was very small. Many of the specimens, too, were bleached by spirit, which ought never to be used for collecting any insects except hard-shelled and smooth *Coleoptera*, *Hemiptera*, &c., which are not liable to be discoloured by it, and have no hair to be matted or delicate exposed wings to be torn.

Nevertheless, though most of the species were common and wide-ranging insects, there were a few interesting forms among them which were either new to, or badly represented in, the Museum Collection. One species I have ventured to describe as new to science; and two or three I am at present unable to determine with certainty, from want of sufficient material.

I will first give a complete list of the species in the Collection (amounting to about 20 in all) and will then discuss them in detail.

I should, perhaps, mention that, as usual in drawing up such small lists as the present, I use the names of the families only in the broadest sense.

ORTHOPTERA.

BLATTIDÆ.

Polyphaga syriaca, Sauss.

PHASMIDÆ.

Phasma ægyptiacum, Gray (?).

LOCUSTIDÆ.

- Sphingonotus nebulosus*, Fisch.
Schistocerca ægyptia, Linn.
S. peregrina, Oliv.
Euprepocnemis littoralis, Ramb.
Pæcilocera vittata, Klug.
Anepisceptus horridus, Burm.
 (2 species of *Locustidæ* undetermined.)

NEUROPTERA.

TERMITIDÆ.

- 1 nymph, undetermined.

HYMENOPTERA.

CHRYSIDIDÆ.

- Stilbum cyanurum*, Forst.
 Var. *amethystinum*, Fabr.

FORMICIDÆ.

- Aphænogaster barbara*, Linn.

SCOLIIDÆ.

- Compsomeris vestita*, Klug.

LEPIDOPTERA (unrepresented).

HEMIPTERA HETEROPTERA.

PENTATOMIDÆ.

- Aspongopus viduatus*, Fabr.

LYGÆIDÆ.

- Lygæus militaris*, Fabr.

REDUVIIDÆ.

- Ectrichodia Andersoni*, sp. n. See p. 284.
 (3 undetermined species.)

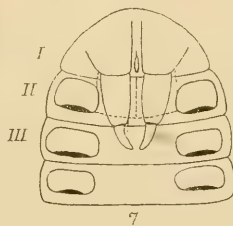
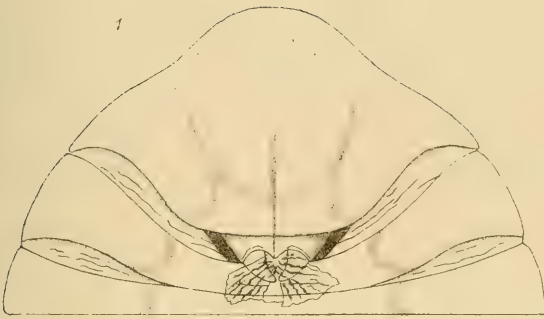
NEPIDÆ.

- Laccotrephes ruber*, Linn.

DIPTERA.

CÆSTRIDÆ.

- Cephalomyia maculata*, Wiedem. (larva).



H.M. Bernard del.
M.P. Parker lith.

West, Newman imp.